FULLY AUTOMATED Z-SCAN SETUP BASED ON A TUNABLE FS-OSCILLATOR

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The z-scan technique has become a standard method to characterize nonlinear absorption of photoinitiators (PI), which have found broad applications in 3D nanolithography, better known as two-photon polymerization (2PP).[1, 2]

There is an increasing need to measure the two-photon absorption (2PA) spectra of newly synthesized PIs and photodynamic therapy substances for biomedical applications.

On the one hand, when such z-scan measurements are performed at the wavelength later used for 2PP, the obtained results might be sufficient for comparison of the expected practical performance of different PI's. However, on the other hand, the true potential of a certain PI design stays unrevealed, if its complete nonlinear absorption spectrum is not characterized. Matching the laser wavelength to the peak of the 2PA spectrum of a particular compound can result in a few fold increase of the PI's performance.

Most z-scan setups are based on amplified laser systems operating at a single wavelength and are practically not capable of characterizing absorption spectra of a PI. High-power tunable femtosecond lasers (wavelengths between 690-1040 nm) offer an alternative approach, which is easily adaptable for scans at different wavelengths.[3]

To ensure reproducibility and accuracy of measurements, we developed an automated algorithm, which collects the required laser parameters. These are automatically stored in a comprehensive library for every single measurement with negligible input by the user. Therefore, even large amount of data is easily handled and correctly evaluated without the need to manually check each measurement.

Due this dramatic improvement in performance and usability, we successfully measured several reference compounds as well as new PIs. The obtained results were reproducible and comparable to measurements performed using amplified systems. New knowledge of the optimal absorption range will have profound effects on the structuring process and can improve the efficiency of two-photon lithography.

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